UNIVERSITY OF OSLO

TIK

Centre for technology, innovation and culture
P.O. BOX 1108 Blindern
N-0317 OSLO
Norway

Eilert Sundts House, 7th floor
Moltke Moesvei 31

Phone: +47 22 84 16 00
Fax: +47 22 84 16 01

http://www.tik.uio.no
info@tik.uio.no

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Emerging innovation modes and (regional) innovation systems in the Czech Republic

Pavla Žížalová

Charles University in Prague, Faculty of Science, Dept. of Social Geography and Regional Development

and

Centre for Technology, Innovation and Culture (TIK), University of Oslo

Abstract

Innovation studies literature has put high importance to sectoral and regional patterns of innovations. This research effort is based upon the argument that industries as well as regions represent quite homogeneous entities with respect to firms' innovation strategies. To the contrary, evolutionary approaches assign more importance to firms' heterogeneity and hence look for groups of firms characterised by similar innovation strategies cutting across the traditional boundaries. The purpose of this paper is to characterize the innovation strategies of Czech firms using explanatory factor analysis and thus first contribute to a better understanding of innovative activities and second, explore whether the identified divergence in innovation patterns can be attributed to the localized conditions or whether it is rather firm-specific. Finally, the paper will discuss the implications of these findings for the literature on territorial systems of innovation, particularly the question how the systems should be delineated, as well as implications for (regional) innovation policy.

Key words: innovation, regional systems of innovation, factor analysis

Introduction

Innovations have lately become a popular catchphrase among European politicians reflecting a broad agreement that innovations are a key source for competitiveness. We might even talk about a new age of innovation. Yet, this is not completely true as already at the beginning of the last century Schumpeter argued that innovations lead to "creative destruction" as they cause old economic routines, technologies, skills, and equipment to become obsolete. This creative destruction, he believed, brings constant economic progress and improvement in the standards of living (Schumpeter 1934, 1942). From the mid-1950s and onwards the neoclassical economic theory acquired widespread dominance and the previous discussion about the role of knowledge and innovations were largely forgotten. However, Schumpeter's (as well as Marshall's) ideas were "reinvented" some decades later and from the late 1970s the discussion about role of knowledge and innovations re-emerged. In recent years, almost all have come to a consensus that today's advanced economies are "knowledge-based" economies – economies directly based on the production, distribution and use of knowledge where learning and innovation creation is the most fundamental activity for competitiveness (Lundvall 1992, OECD 1996). Hence, we might say it is generally believed that to successfully compete in the 21st-century highly globalised economy, companies must reinvent their processes and culture in order to sustain innovative solutions. Support innovation creation has become core of many public economic development strategies and programmes.

Despite the quite evident importance of innovations, we need to acknowledge that the phenomenon is far from well known and understood. Yet, in order to efficiently support innovation creation, there is a need to understand how firms innovate. The innovation process is a complex phenomenon. Innovation can take many forms – from simple, incremental "new-to-firm" innovation to radical innovation of an entirely new product. It can range from changes in the firm`s products or services through methods of delivering this offering to changes in internal managerial system of the company. As the innovation itself varies, so does its creation. The innovation creation process involves several stages including both in-house and external activities. Innovations are long not seen as a linear process which was regarded as extremely simplified. Innovations are seen rather as interactive and systemic phenomenon. The interactive and system models of innovation have brought together technology push and market pull recourses as well as interactions with wide spectrum of agents providing new insights how innovation occurs in firms. At the same time it seems the more we study the innovation process, the more we realize how complex it is (Marinova, Philimore 2003). Hence it might lead even to confusing conclusions from the government policy perspective. The challenge is, therefore, to ensure a broad, integrated view to underpin the structures and processes firms put in place to create innovations and at the same time provide simplified guidelines for the policymakers to be able to develop efficient tools.

This paper takes up the challenge of studying innovation patterns in a post-communist country with still rather under-developed knowledge based economy aiming to contribute to shed light on firms' innovation behaviour from its perspective. The reason is that, so far, empirical research has focused mainly on highly developed countries such as Western European countries (see e.g. Hollenstein 2003, De Jong, Marsili 2006, Kristensen 1999, Leiponen, Drejer 2007, Veugelers, Cassiman 1999). However, the research carried out by the author up to now has shown that Czech Republic might differ significantly from the generalized experience. This might be attributed partly to its distinct economic level and structure but also to its rather specific historical and institutional context. As stated recently in David (2005), the intellectual traditions within economies and cultures can be interpreted as paths with their own trajectories shaped by preceding events and accumulated knowledge, yet it might be

applied to the economy as a whole too. Additionally, we aim to investigate the regional dimension of the identified innovation patterns and examine to which extent one might observe distant regional dynamic and emergence of specific regional innovation systems in the Czech economy.

The rest of the paper is organized as follows. First, several taxonomies and previous studies as well as key theoretical concepts are reviewed as a starting point to develop a conceptual framework for our analysis. Next, we describe the data and the methodology used in searching for innovation modes in the Czech Republic. In section 4, the empirical analysis identifies, analyses and interprets firms innovation strategies and explores whether the identified divergence in innovation patterns can be attributed to the localized conditions (i.e. is region-specific), put differently we examine to which extent the boundaries of different innovation patterns might be aligned with administrative regional boundaries as the regional innovation system concept assumes. Finally, we discuss the main results and draw some conclusions and implications of our results for future theoretical and empirical research as well as for (innovation) policy agenda.

How do firms organize innovation – the theory

The research of innovation patterns and the question what strategy firms pursue to create innovations is closely related to taxonomies analyses since the pioneering and highly cited study of Pavitt (1984). Through taxonomies researchers are trying to generalize and describe different modes of innovation creation classifying different items into relatively homogeneous groups. The advantage of taxonomies is the fact that they significantly reduce a complexity of empirical phenomena providing useful framework for both innovation studies research and innovation policies (De Jong, Marsili 2006).

Besides Pavitt (1984), taxonomies research has been also inspired by Schumpeter and his work on innovations (Schumpeter 1934, 1942). This strand of literature proposed two alternative patterns of innovations, so called Schumpeter Mark-I and Mark-II patterns. The first pattern is associated with innovations generated mainly by the entrepreneurial activity and creativity of small and new firms while in the Mark II pattern, innovations originate in large and established firms in relevance to formal R&D activity (Malerba, Orsenigo, 1996, Nelson, Winter, 1982).

Both these strands intended to reflect inter-sectoral diversity of innovation patterns taking firms as main subject of their analysis. Though acknowledging that firms do not innovate in isolation but depend heavily also on external sources, they abstracted from the external conditions in which the firms are embedded. From the 80s, however, scholars started to put more emphasis on the wider framework in which innovations in firms are created and on so called systemic nature of innovation (Edquist 2005). Edquist (2005) notes that firms innovate in collaboration and interdependence with other organizations and that their behaviour is shaped by institutions which constitute both incentives and obstacles for innovation. Much of the early work on innovation systems was conducted at the national level (Edquist, 1997, Lundvall, 1992, Nelson, 1993). Iammarino (2005) summarizes that the original systems of innovation approach assumed that key decision-making processes regarding the aggregate of micro-founded innovation activities are taken at a macro (national) level. Similar to this approach and following the previous taxonomies research, sectorally delimited IS appeared in the literature (e.g. Breschi, Malerba 1997). The main thrust of these concepts is that the way how firms innovate is to a great extent determined by the sectoral and/or national boundaries. Both concepts have gained strong popularity also among policy makers as they respond well to requirements of policy making – central level is still highly important in the sphere of

science, technology and innovation policies and governments are interested in targeting their support towards certain industries (Havas 2006, Raymond et al., 2004).

Both the sectoral and national/regional innovation system concept assume that different innovation patterns may be seen as the result of specific "external" conditions. While in case of sectoral innovation systems those might be associated with specific sectors or technological regimes inspired by Nelson, Winter (1982) or Dosi (1988), the national innovation system concept supposes that innovation patterns are rather country-specific. This may be related to the existence of specific historical (industrial) development and related set of institutions, both formal and informal (such as norms, conventions or rules) prescribing behavioural roles and actions (see e.g. Doloreux, Parto, 2004, Martin, Sunley, 2006, Fagerberg et al., 2008). In addition, these institutions are persistent and change slowly, only in evolutionary time (North, 1990).

More recently, the importance of regional scale in stimulating innovation capabilities was rediscovered thanks to the emergence of successful clusters of firms and industries in many regions around the world (Doloreux, Parto, 2004). Lately Maskell, Malmberg (2007) argued that initially random territorial nuances in institutional pattern deepen over time creating distinctive institutional combinations along not only national but also regional and local lines. This re-discovery led to the emergence of new concepts from which the regional innovation systems (RIS) have gained probably the most popularity (Asheim, Isaksen, 2002, Braczyk et al., 1998, Cooke, 2003, Doloreux, 2002, Koschatzky, 2004).

Similar to the national innovation systems concept, regional innovation systems advocates argue that innovations are increasingly highly dependent on localized or regionally based sources of knowledge and learning and localized, embedded capabilities such as institutions (Maskell, Malmberg, 1999). Storper (1997), hence, argues that regions develop specific array of intangible assets which help them to build and keep its distinctive capacities. Besides, the RIS concept advocates also argue, following the marshallian industrial districts concept (see e.g. Asheim, 2000) that innovation activities benefit from the concentration of economic activity and geographical proximity.

Since its first definition, the RIS concept has become increasingly popular, not only among scientists such as economic geographers, but also among policy makers both at national and European level (see e.g. Fritsch, Stephan, 2005, Morgan, 1997, Moulaert, Sekia, 2003, Tödling, Trippl, 2005). While the literature on RIS has provided extensive description of the relationship between innovations, learning and territory, it failed to provide the empirical validity to the delineation of the RIS as well as the conception of innovation as geographical, localized phenomenon. According to Doloreux, Parto (2004) there have been two main sets of studies based on the RIS framework. The first is based on comparative empirical studies of various regions aiming at identifying generalities and particularities of their RIS. The second set offers studies of usually successful, individual RIS. Both sets of studies have resulted in the descriptions of various types of RIS leading to a rather confusing conclusion that there are RISs everywhere. However, the studies failed to define clearly how to specify the boundaries of those RIS. Majority of the studies take as a point of departure an administrative region which they associate with RIS. Cooke (2005) argues that to define a region administratively is necessary as in the field of regional development region is intended to govern policies to assist processes of (regional) economic development. He also adds that the concept of "region" has its origin in the Latin region from *regere* meaning "to govern" (Cooke 2005, p. 1134). Though it seems clear there is no empirical justification why administrative regions should be considered as specific RISs and at which scale. Cooke (2005) defines regional only as "nested territorially beneath the level of the country, but above the local or municipal

level". Hence, the studies carried out under the framework of RIS concept include all variety of "regions" – from city level (Simmie 2002) through European NUTS III or NUTS II regional level (Buesa et al., 2006, Heidenreich, Krauss, 2004) up to whole countries such as Denmark (Maskell, 1998). In all these studies, the regions were considered as RIS a priori and the analysis were focused mainly on its description yet not on delimitation.

However, lately some works have shown, both in quantitative, statistical and in more qualitative, case study approach analysis, that firm-specific characteristics might play a key role in shaping the way in which firm innovate while country and industry matter only to a limited extent (see e.g. Srholec, Verspagen 2008). Following this strand of research yet focusing on the regional level, this paper aims to take a different, bottom-up approach in the analysis of emerging RISs departing from the firm-level analysis. First, we aim at analyzing the differences in innovation patterns in the Czech Republic identifying key innovation strategies of Czech firms. These results are compared with similar studies focused on more developed countries in order to describe to which extent Czech companies have so far adopted similar or rather distant innovation strategies. Next, we analyse whether the identified innovation strategies differ significantly across the administrative regions. We assume there might emerge rather distant regional innovation patterns, hence different regional innovation systems mainly due to quite significant regional disparities. The Czech Republic inherited very small regional differences from its communist past and these differences grew quite slowly until the second half of 90s. The findings of Blažek, Csank (2007) showed that over the course of the 1990s regional disparities intensified at both the mezo-regional (regional) and the micro-regional level. According to Blažek (2005) the Czech Republic encompasses the second largest disparities from EU member states of a comparable size[1]. This study has analysed rather traditional indicators such as GDP, or unemployment rate which are also presented in the table 1. Significant regional differences are found even in capacities in the sphere of R&D, not only in overall characteristics but also in the private (business) sector which is analysed in this paper (see table 2).

Similar disparities might be also observed in output indicators. In the studies of technological progress, patents were often used to measure a direct output of industrial R&D and other inventive activity and also to mirror the cumulative process of technological change. Here, we use them only to illustrate the existing regional disparities in the Czech Republic and therefore only patents registered at the Czech Industrial Property Office are illustrated. The Figure 1 clearly confirms quite significant differences not only at regional but also at intra-regional level in the sphere of knowledge-based economy. Patents are concentrated particularly in regions with stronger business R&D activities such as the metropolitan area of Prague or Jihomoravský and Pardubický regions (see figure with administrative regions borders in appendix C). Thus, due to the variety of regions with different modes of behaviour, where the capacities vary from one region to another we suppose there are regional disparities in innovation activities as well.

[1] These countries included, apart from the Czech Republic also Austria, Belgium, Greece, Hungary, Portugal, Slovakia and The Netherlands.

Table 1: Regional disparities in the Czech Republic – selected economic indicators

Region	GDP per capita (2004)		GDP growth (1995 = 100)		Unemployment (2004)	
	CZK	% of national average	2000	2004	%	% of national average
NUTS II						
Praha	567 946	205,9	122,8	139,0	3,9	46,9
Střední Čechy	262 192	95,1	119,1	143,5	5,4	64,9
Jihozápad	255 481	92,6	105,5	121,2	5,8	69,5
Severozápad	223 541	81,1	92,8	101,7	13,1	157,5
Severovýchod	234 492	85,0	106,5	116,0	6,7	80,4
Jihovýchod	246 683	89,5	105,3	118,6	7,9	94,8
Střední Morava	217 705	78,9	100,5	114,2	9,8	118,2
Moravskoslezsko	226 089	82,0	96,1	108,1	14,5	175,3
NUTS III						
Pražský	567 946	205,9	122,8	139,0	3,9	46,9
Středočeský	262 192	95,1	119,1	143,5	5,4	64,9
Jihočeský	246 523	89,4	106,5	118,7	5,7	68,9
Plzeňský	265 681	96,3	104,4	123,9	5,8	70,2
Karlovarský	214 218	77,7	94,5	99,6	9,4	113,3
Ústecký	226 991	82,3	92,1	102,5	14,5	174,1
Liberecký	221 558	80,3	106,2	110,8	6,4	77,2
Královéhradecký	247 572	89,8	108,9	119,1	6,6	79,4
Pardubický	231 273	83,9	104,0	116,9	7,0	84,3
Vysočina	235 264	85,3	108,9	126,3	6,8	82,5
Jihomoravský	251 841	91,3	103,7	115,6	8,3	100,4
Olomoucký	216 033	78,3	102,1	118,0	12,0	144,9
Zlínský	219 514	79,6	98,9	110,5	7,4	89,4
Moravskoslezský	226 089	82,0	96,1	108,1	14,5	175,3
Czech Republic	275 770	100,0	107,5	121,7	8,3	100,0

Source: CZSO – Regional accounts 2006, 2004; Labour force survey 2004.
Note: Relative values in % are related to the Czech Republic value designated as 100.

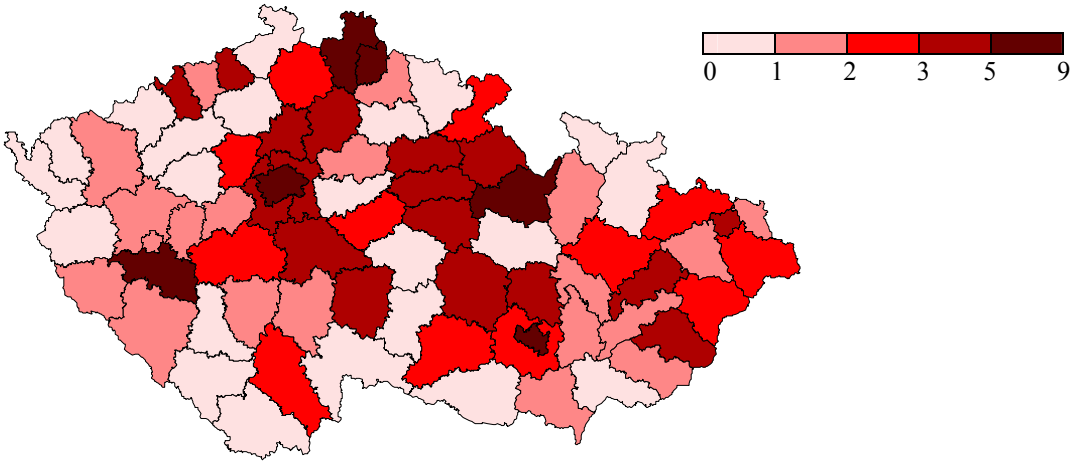
Table 2: R&D expenditure (thousands CZK), 2006

Region (NUTS III)	Total R&D expenditure	Private sector			Public sector		
		total	domestic	foreign[2]	total	higher education	government
Praha	19 576 704	7 862 569	2 846 622	5 015 946	11 714 135	3 781 019	6 207 592
Středočeský	9 023 283	7 649 009	1 561 301	6 087 709	1 374 274	1 103	1 180 210
Jihočeský	1 543 472	839 216	275 988	563 228	704 256	285 435	394 702
Plzeňský	1 282 028	928 404	580 828	347 575	353 624	335 676	10 947
Karlovarský	69 632	66 430	32 724	33 706	3 202	0	3 202
Ústecký	610 653	517 962	408 114	109 848	92 691	75 851	4 855
Liberecký	1 342 831	1 169 539	688 263	481 276	173 292	169 069	1 250
Královehradecký	747 653	631 590	398 304	233 286	116 063	29 793	3 981
Pardubický	1 853 560	1 567 892	978 002	589 890	285 668	188 817	405
Vysočina	471 759	468 477	339 144	129 334	3 282	0	3 282
Jihomoravský	4 612 171	1 940 232	1 158 409	781 823	2 671 939	1 638 629	851 699
Olomoucký	1 581 927	802 805	479 364	323 441	779 122	446 596	160
Zlínský	1 631 794	1 527 335	865 471	661 865	104 459	103 466	993
Moravskoslezský	5 552 804	4 913 698	921 454	3 992 244	639 106	523 312	67 964

Source: CZSO, own analysis

[2] Foreign firms – firms under foreign control; in these firms more than 50 % voting rights belong to foreign investor (foreign parent firm) (ČSÚ 2007).

Figure 1: Number of patents registered at Czech IPO per capita, 1995-2005



Source: IPO

On the other hand, the 14 self-governing regions were created first in January 2001, yet the transfer of new competences from the national level was rather slow and it has only been accomplished by 2005 accordingly to Blažek, Uhlíř (2007). Being still at the beginning of their existence, the political power and the actual capacity of the regions to prepare and manage development projects remains very low. Another weakness is lack of co-operation in the sphere of regional development planning culture demonstrated particularly by a low involvement of the business community. These represent, however, important factors for developing particular regional context with specific set of common rules, conventions and norms. One might therefore question the role of current administrative regions in the sphere of innovation systems as they were established only recently and do not have to correspond to natural economic relations.

Data set and methodology

The analysis is based on firm-level datasets from two Community Innovation Surveys (CIS) covering the periods 2003-2005 and 2004-2006. The method used in innovation surveys is based on the Organization for Economic Co-operation and Development's (OECD) Oslo Manual (OECD, 1997). Firms were asked to fill in a harmonized questionnaire yielding answers about several aspects of their innovation activities. Because of the structure of the CIS survey questionnaires, only firms that introduced product and/or process innovation responded to all these questions and thus only product and/or process innovators were included in the analysis. After omitting incomplete records, the surveys provide a dataset of 4 771 innovating companies from both manufacturing and services. Some basic information about the companies in the sample is presented in the table 3.

Table 3: Structure of the firm sample

Size	Product innovation	Type of product innovation in %[1]			Process innovation	Total
		New to firm	New to market	Both		
< 49 emp.	1 156	48,4	31,0	20,7	1 362	1 702
50-249 emp.	1 108	41,8	30,9	27,3	1 238	1 491
> 250 emp.	1 271	39,5	27,2	33,3	1 403	1 578
Total	3 535	43,1	29,6	27,3	4 003	4 771

Note: [1] Firms were able to specify whether any of their goods and service innovations were new to their market or new only to the firm. In case firms implemented several innovations, both options might have been chosen.

Following Srholec, Verspagen (2008), innovation patterns are identified through a two-step data analysis. First an exploratory factor analysis (see e.g. Lewis-Beck 1994) is performed, using the principal component method, on the groups of variables listed in appendix. The factor analysis enables to determine a lower number of hypothetical variables containing practically all the information in the original set. Contrary to similar studies (e.g. Hollenstein 2003) we do not select the variables for the factor analysis a priory, yet we intend to include as much relevant information as possible to let the analysis decide what the key elements in the innovation strategies of the Czech firms are (the variables included in the analysis are described in Appendix A). At the same time we are aware of the problem of including redundant information which might produce "inflated" factors. So, we include only questions bringing new insights about the innovation process. At the same time, in the current analyses, we are constrained by the contents of the CIS datasets. Next, the scores obtained from the first-round factor analysis are input into a second-round factor analysis in order to identify the innovation patterns.

The extraction method in both steps is the principal component analysis which aim is to reduce the dimensionality of a variable set and explore the structure of a data set. The original solution is transformed to a rotated solution which brings a simple and more easily interpretable structure. In other words, the rotated solution fits in with the simple structure principle under which variables are saturated in a different factor. For this purpose, the varimax rotation was used and only principal factors with eigenvalue larger than one were retained for rotation.

The innovation patterns identified are then discussed in relevance to the theoretical framework of this paper as well as in relevance to results of similar studies. In such a way we aim to assess the role of specific historical and institutional context of the Czech Republic in shaping the firms innovation strategies. Next, we explore whether firm behaviour in relation to innovation creation is region specific by examining the distribution of the factor scores across the administrative regions at NUTS III level. Lastly, the role of the regional level is also tested statistically using regression analysis. We control for other basic factors that might explain the innovation strategies including variables for firm size, industry and ownership.

How do firms organize innovation – empirical results

The innovation process consists of several interdependent stages. In the past, as only limited data were available, the typologies were proposed based on simple descriptive methods or the studies focused only on a particular dimension of the multidimensional phenomenon. As the data from innovation surveys became available, it has proved to be useful to try to connect and describe all the dimensions of the innovation process. In recent studies, factor analysis has been used in research on innovation demonstrating it helps in identifying structures in innovation process. Following Srholec, Verspagen (2008) we use a hierarchical, two step factor analysis in order to ensure a realistic representation of all the dimensions of the innovation strategy. Alternative approach would be to include all the variables at once. However, this led to grouping rather particular sets of questions, hence only certain dimensions of the innovation strategy.

First, we provide the results for the first step of our analysis to present what are the strategies in particular dimensions of the whole innovation process. Overview of the results is presented in tables 4 to 9. So-called factor loadings are reported in the tables. The factor loading is a correlation coefficient between the different variable of the analysis and the common factor extracted in a so-called factor pattern.

Table 4 reports results of factor analysis on different innovation activities performed by firms. Two distinct factors were detected. We label the first one "R&D" as it loads highly on R&D activities, both in-house and external. Beside these, it also correlates with activities related to market introduction of new products/services and other activities (e.g. technical preparations) related to implementation of firms` new products or services. This factor involves all the stages related to a model of innovations which might be simplified as "science and formal R&D goes in and new products come out". Even though the activities seem similar to a linear model of innovation, it cannot be associated with it as they do not necessarily represent a one-way successive process. This result is slightly different compare to e.g. Srholec, Verspagen (2008) where "R&D" and "market introduction" activities created separate factors. The results here might be therefore attributed to specific characteristics of Czech companies R&D activities. These are still oriented above all towards applied research and development activities (see e.g. Žížalová, Csank, 2009) aiming to lead to swiftly commercializable products rather than towards high-end research. Czech firms R&D activities are so linked strongly to immediate market introduction and so they tend to combine R&D activities with market introduction and other procedures and technical preparations needed to implement their innovations. The second factor detected for innovation activities correlates highly with acquisition of machinery, equipment and software purchased to implement innovations, acquisition of external knowledge and training. We label this principal factor "External sources" and it might be associated with the "buy" strategy complemented by employees training. Yet, the training activities might be out-sourced as well.

Table 4: Factor analysis on innovation activities – extracted factors and factor loadings

	R&D	External sources
In-house R&D	0.74	-0.23
External R&D	0.53	0.22
Machinery acquisition	-0.16	0.72
External knowledge acquisition	0.26	0.56
Training	0.39	0.58
Market introduction	0.68	0.16
Other innovation activities	0.64	0.21

Note: Number of observations 4 771; two factors with eigenvalues > 1 explain 46.7 % of total variance.

Table 5 summarizes the factor analysis results on different information sources used by the companies for creating innovations. Here, three factors were detected. First, there is a separate principal factor for "Research information", which puts together information from the both public and private research institutes/organizations and universities. It also loads slightly on information from conferences, journals and particularly professional or industry organizations. These might be considered as tools through which firms communicate with or gain information from academics and researchers. All these three information sources are separately combined in the second factor. Again, this factor seems quite specific compared with previous studies and it may be attributed to rather low level of co-operation on innovating activities among Czech companies (see e.g. Žížalová, 2008). It shows there are firms focusing on generally available information and taking the opportunity of common temporary events like fairs, congresses, etc. The last factor combines information from suppliers, clients or competitors and other firms in the same industry with information from within the enterprise. All of these sources are related to business sector and might be related to the interactive, horizontal model of innovations. This factor is therefore labelled "Business information".

Table 5: Factor analysis on information sources – extracted factors and factor loadings

	Research information	Event and specialized information	Business information
Within enterprise	0.28	-0.18	0.59
Suppliers	-0.02	0.36	0.43
Clients or customers	0.05	0.19	0.80
Competitors or firms from the same industry	0.12	0.28	0.73
Private R&D institutes	0.68	0.12	0.27
Universities or other higher education institutes	0.82	0.19	0.06
Government or public R&D institutes	0.79	0.17	0.04
Conferences, trade fairs, exhibitions	0.16	0.79	0.15
Journals and technical publications	0.25	0.79	0.14
Professional and industry associations	0.46	0.49	0.09

Note: Number of observations 4 771; three factors with eigenvalues > 1 explain 58.3 % of total variance.

The third set of questions used in this analysis includes geography of co-operation. Here, only one factor was detected (table 6) by the analysis showing that when firms co-operate, they tend to combine various partners at various geographical levels. This result is rather contradictory to the literature on geography of innovation and regional innovation systems. Current literature stresses that both local and global interactions are sources to maintain or even increase competitiveness and growth (Bathelt et al., 2004, Asheim et al., 2007). Yet, both types of linkages are not similarly important for different types of knowledge, innovation or innovation systems – while territory and proximity play a central role in the transmission of tacit knowledge, global pipelines serve mainly as source of codified knowledge (Bathelt et al., 2004). Therefore, we would expect that some firms would focus on local (national) linkages while others would prefer globally distributed partners. It might be argued that the results are biased by firm size as bigger firms tend to have more dispersed linkages. Therefore we tested the same variables excluding firms with more than 250 employees. The results are very similar – only one factor was detected with only slightly lower factor scores for the USA and World co-operation dimensions.

Table 6: Factor analysis on co-operation – extracted factors and factor loadings

	Geography of co-operation
Cooperation CR	0.72
Cooperation Europe	0.78
Cooperation USA	0.70
Cooperation World	0.68

Note: Number of observations 4 771; one factor with eigenvalue > 1 explains 52.2 % of total variance.

Table 7 shows results for the factor analysis on the effects of (or motives for) innovations. The analysis detected two factors distinguishing between “Process and regulations effects” and “Product effects”. This distinction shows a certain specialization according to innovation types though some firms implement more innovation types simultaneously. On one hand firms focus on product innovations associated with increase in range of goods, improvement of quality and increase in market share. On the other hand they implement process innovations motivated particularly by cost reduction and innovations related to the need of reducing negative environmental impact, improving safety and health aspects and meeting regulations. There are other two variables which load quite similarly to both factors. These are

improvement in production flexibility and increase in production capacity. These results might point out to still specific characteristic of the Czech companies and their need to modernize and improve the production method.

Table 7: Factor analysis on effects of innovations – extracted factors and factor loadings

	Process effects and regulations	Product effects
Range of goods	0.05	0.83
Market share	0.19	0.83
Quality in goods	0.28	0.71
Production flexibility	0.55	0.40
Production capacity	0.48	0.58
Labour costs	0.73	0.34
Materials and energy	0.77	0.30
Environmental aspects	0.78	0.11
Regulations	0.74	0.03

Note: Number of observations 4 771; two factors with eigenvalues > 1 explain 61.6 % of total variance.

Table 8 describes two factors which came out from the factor analysis on methods of protection. The first factor is labelled "Industry protection" as both methods loading highly on this factor are particularly important for manufacturing industries. The second factor loads on the other two forms of protection which are related to protection of more diverse products. Trademarks are related to visual symbols such as a word, signature, name, label, combination of colours etc. which help in distinguishing goods or services originating from one source from that of other sources. Copyright is a bundle of rights granted to the creators of literary, dramatic, musical or artistic works and other related activities. Both methods are linked more closely to creative and symbolic activities and industries; therefore we label this factor "Symbolic protection".

Table 8: Factor analysis on methods of protection – extracted factors and factor loadings

	Industry protection	Symbolic protection
Patent	0.85	0.03
Industrial design	0.83	0.15
Trademark	0.24	0.73
Copyright	-0.05	0.85

Note: Number of observations 4 771; two factors with eigenvalues > 1 explain 68.5 % of total variance.

The last first-step factor analysis was carried out on questions related to organizational and marketing innovations. Similar to the question on co-operation, only one factor was detected. It seems thus that all the changes occurring in the firm are related to each other. The last factor is labelled "Non-technological innovations".

Table 9: Factor analysis on organizational and marketing innovations – extracted factors and factor loadings

	Non-technological innovations
System of management	0.69
Work organization	0.72
Organization	0.67
Design and packaging	0.62

Distribution method	0.59

Note: Number of observations 4 771; one factor with eigenvalue > 1 explains 43.7 % of total variance.

As described previously, in the next step we carry out a factor analysis on factor scores detected in the previous steps. The aim of this analysis is to identify key innovation modes of the Czech companies. Table 10 gives the results. Four factors which might be associated with basic modes of innovations were identified.

Table 10: Second phase factor analysis – extracted factors and factor loadings

	Research networked	Market oriented	External ("buy")	Non-technological
R&D linear model	0.62	0.45	0.02	0.15
External sources	-0.09	0.02	0.69	0.16
Research information	0.76	-0.18	0.09	0.16
Event and specialized information	0.06	0.20	0.56	-0.43
Business information	0.01	0.76	0.10	0.12
Geography of co-operation	0.60	0.17	0.17	0.12
Process effects and regulations	0.22	-0.02	0.69	0.07
Product effects	0.12	0.83	-0.01	-0.02
Industry protection	0.62	0.10	-0.10	-0.34
Symbolic protection	0.08	0.12	0.07	0.73
Non-technological innovations	0.30	0.37	0.36	0.44

Note: Number of observations 4 771; four factors with eigenvalues > 1 explain 56.2 % of total variance.

The first factor loads highly especially on R&D activities, use of research information, co-operation and industry protection. We labelled this mode *"Research networked"*. It can be associated with science-based firms with full network integration as the co-operation factor includes co-operation at various geographical levels. Innovation output consists probably of both new products and processes which are new to the market (or industry) as the firms on this path to innovation tend to highly protect their knowledge by formal methods including patents and industry design protection.

Second mode labelled *"Market oriented"* is based on interactions within the business sector and is oriented towards product innovations. New products are developed mainly according to signals from clients, suppliers and firms in the same industry. Nevertheless, formal networking (i.e. participating in joint innovation projects with other organizations) is rather limited and the co-operation takes probably more informal forms. Internal within enterprise information sources seem to be important as well as this innovation mode correlates also with the R&D factor. So, beside external information sources, the firms following this strategy count upon their own capabilities and employees. This result is rather reassuring as the R&D factor also includes market introduction and other technical preparation activities related to the implementation of the innovations. Innovation in this mode might have rather incremental character as none of the intellectual property protection methods is crucial here.

Use of external sources and implementation of process innovations aimed at cost reduction and regulations acquaintance are the most prominent features of the *"External"* mode of innovations. Firms following this path exploit existing technologies and knowledge from other organizations by purchase in various forms. Information about the technologies and know-how available are gained mostly through participation at various specialized, professional events or through journals and technological literature. Hence we might associate

this mode with the "buy" strategy as internal innovation sources seem to play a minor role. Similar to the former mode, methods of protection do not seem to be used frequently. This might be attributed to the fact that most of the knowledge used in this mode is likely to be already available on the market.

The last innovation mode detected, *"Non-technological"*, is probably the least clear. It loads highly on the non-technological innovations factor, yet this type of innovations seems to be important in case of the other three modes as well. Beside this factor, it correlates highly with the use of symbolic methods of intellectual property protection. As the loadings on all other factors are very low, we might associate this mode with "remaining" firms with no clear-cut innovation strategy and rather ad-hoc incremental innovations. In addition, as the symbolic protection methods seem highly important for this innovation mode, it might be also associated with so called creative or symbolic industries such as media (film making, publishing, and music), advertising, design or fashion. The eigenvalue for this factor was the lowest and only slightly above 1, so we also tested the factor solution determining only 3 factors. Here, the non-technological innovations and symbolic protection methods were to very similar extent correlated with the "market oriented" and "external" innovation modes. This supports the assumption that these strategies play more important role for incremental innovators.

The previous analysis shows that the identified innovation modes of the Czech companies are quite similar to those identified in previous studies focused on more developed countries. We have identified both R&D intensive innovation strategy and more externally oriented modes related to the so-called interactive model of innovations. It also shows that even though the private research activities went through difficult period and were significantly diminished in previous period, they were recently able to recover to a certain extent. The differences in our results might be attributed to the character of R&D activities. In case of Czech firms R&D is oriented more towards applied research closely linked to market needs as discussed above. Yet, the factors itself can`t say much about how important these modes are, they only demonstrate their presence in the Czech innovation system. We might therefore only speculate whether the "external" innovation mode would be the most often due to technological gap between the Czech Republic and the most developed countries in Western Europe.

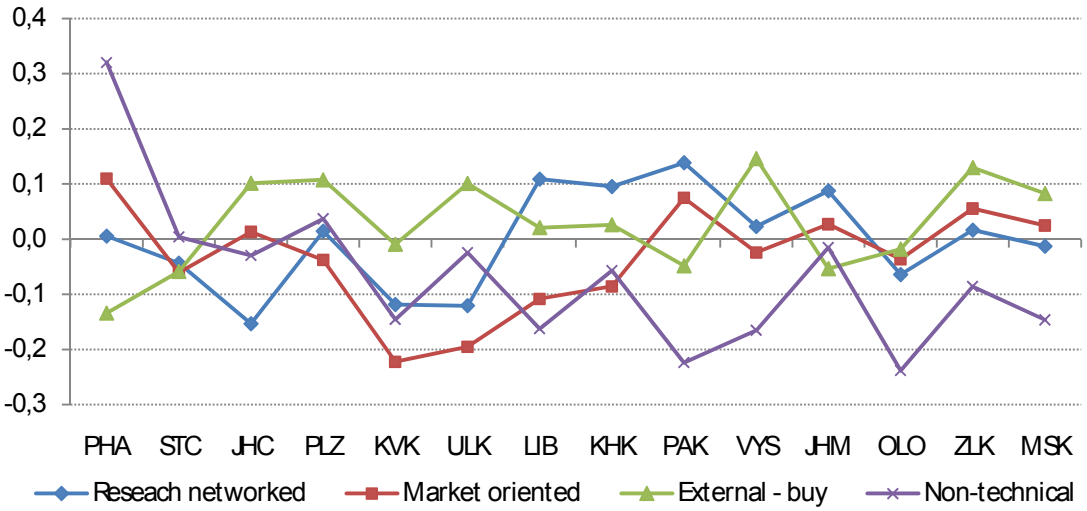
Another specific feature of research in the Czech Republic under Communism was a strict separation of basic and applied research, the former carried out mainly in the research institutes of the Czechoslovak Academy of Science which were not expected (in many cases still are not) to come up with results that could be commercialised. According to our results, the role of co-operation seems to play comparable role as in similar studies – co-operation in the form of joint innovative projects is important mainly for the research intensive innovation mode. In case of other modes, probably more informal co-operation takes place, often in forms of day-to-day or ad-hoc contacts, negotiations and meetings. Again, the results do not say anything about the extent or intensity of the co-operation, only the basic pattern seems quite similar in the Czech Republic as in earlier EU Member States.

So, even though the Czech Republic has followed rather specific path in the past, it seems to be returning to (for many a natural) path followed by the western European countries. First conclusion from this seems that when firms decide to innovate, they have only certain possibilities of paths towards successful innovations. Nevertheless, they might never be associated only with R&D activities and capabilities of purely technical nature as it is still too often stressed both in policy and literature (see e.g. Srholec, Verspagen 2008, Asheim, 1999 for similar critique).

What is the role of regional level in the differences of innovation modes?

The second research question of this analysis is related to the role of regional level or regional dimension for the identified innovation modes. First, we present simple descriptive results comparing how the detected innovation modes are represented across the Czech administrative regions. The figure 2 reports the regional means of the factor scores of the four identified innovation modes. The differences across the 14 regions seem rather minor with the exception for the last factor and the capital city of Prague region. The quite different position of the Prague region is partly confirmed also by the figures in appendix B presenting the maximum, minimum and mean values for the four innovation modes across the 14 Czech regions. Overall, the differences across regions seem small and do not seem to reflect the existing disparities in for instance R&D input and output indicators presented in the previous section.

Figure 2: Regional factor scores means for the identified innovation modes according to 14 Czech NUTS III regions



Note: For the regions code see Appendix D

To further confirm the previous rather descriptive analysis, we use a multiple linear regression model. The aim is to analyze whether or not the regional level plays a significant role when "explaining" the innovation modes. The dependent variables in the analysis are the factor scores for the four principal factors detected in the second-step factor analysis. The OLS regression analysis is used because the factor scores show normally distributed values. As independent variable we include the dummies for the 14 self-governing regions. It may be objected that this level is not detailed enough to use for the explanation. Yet, our aim is to analyze whether we might associate different innovation modes with specific administrative regions as these are generally associated with RISs. As the literature on innovation often assumes that the nature of innovation patterns also differs across industries and different types of firms, we incorporate several control variables including log of firm size and dummies for ownership and industry (32 groups according to NACE-codes) too.

First, the OLS analysis was computed only for the control variables in order to examine what percentage of the sample variation might be explained by these indicators (see table 11). The coefficient of determination for this test-analysis will be then compared to the results when also the NUTS III dummies were included. The fraction of the sample variation explained by only the control variables varies from 4.7 % to 21 % for the 4 innovation modes. This is in line with previous studies focused on the role of sectors when explaining variations in

innovation modes. These studies, particularly Srholec, Verspagen (2008) and Leiponen, Drejer (2007), have shown that most of the variance might be attributed to heterogeneity at the firm-level. The firm-level is represented here only by simple variables and therefore the fraction explained by them is rather low. When the NUTS III variables are added into the model, its values increase only slightly from 5.5 % to 21.5 % respectively. This suggests that the regional level does not attribute significantly to the explanation of the variance in innovation modes.

Table 11: Regression on innovation modes for control variables – coefficients estimates

	Research networked		Market oriented		External ("buy")		Non-technological	
	B (st. error)	beta	B (st. error)	beta	B (st. error)	beta	B (st. error)	beta
(Constant)	-1.066 (0.056)		-0.474 (0.059)		-0.440 (0.061)		-0.193 (0.060)	
Size	0.206** (0.010)	0.312**	0.074** (0.010)	0.113**	0.103** (0.011)	0.156**	0.088** (0.010)	0.133**
Ownership (foreign)	-0.015 (0.031)	-0.007	-0.033 (0.033)	-0.015	-0.033 (0.0349	-0.015	0.166** (0.033)	0.075**
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.210		0.110		0.047		0.088	

Note: Number of observations 4 771; ** significant at 0.01 level, * significant at 0.05 level

Results for the regression analysis are presented in the table 12. When binary variables are included in the model, one option always serves as a base group against which comparisons are made. Hence, the results depend on which group is chosen for the benchmark. Therefore, the results were tested for all the options for all four innovations mode though only the results where the region of the capital city of Prague was chosen as base are presented in the table. The reason is that Prague is the "most different" compared to the rest of the regions, otherwise the results were similar for all the options (slightly different coefficients yet similar results for "significant" or "not-significant").

The regression analysis confirms the results of the previous descriptive analysis. Regions do not seem to play a decisive role in differentiation of the innovation modes and the differences might be explained rather through firm characteristics such as size, industry or other variables not included in this analysis. On the other hand, it seems that some of the defined innovation modes tend to "concentrate" more in selected region(s). This applies particularly for the last two modes. In case of the external innovation mode we can assume that the firms located in Prague follow this strategy less often than firms from some of the regions with significant coefficients. This is in line with the concentration of R&D capacities in the capital city. Prague firms thus rely more often on their capacities and development of new knowledge rather than on purchase of existing technologies and/or know-how. In case of the non-technological innovation mode we might on the other hand observe a stronger "concentration" in the capital city. The non-technological innovation mode was associated with so called "creative" industries which tend to cluster in metropolitan regions and specific urban areas (Asheim et al. 2007). Prague is a leading centre for these industries (or for the industries which might be determined by the available classification, see appendix C) in the Czech Republic which has been reflected in its specific position in the last innovation mode.

Overall, Prague is the only region which seems slightly different according to the innovation modes described here, yet in most cases it is not significantly different. Hence, we might conclude here that when it comes to the way how firms innovate, the regional (administrative) boundaries do not seem to represent a decisive differentiating factor.

Table 12: Regression on innovation modes – coefficients estimates

	Research networked		Market oriented		External ("buy")		Non-technological	
	B (st. error)	beta	B (st. error)	beta	B (st. error)	beta	B (st. error)	beta
(Constant)	-1,038 (0.062)		-0,420 (0.066)		-0,572 (0.068)		-0,048 (0.066)	
NUTS III								
Středočeský	-0,070 (0.052)	-0,021	-0,101 (0.056)	-0,030	0,103 (0.057)	0,030	-0,128 (0.056)	-0,038
Jihočeský	-0,171 (0.062)	-0,040	-0,064 (0.066)	-0,015	0,246** (0.068)	0,057**	-0,204 (0.067)	-0,048
Plzeňský	-0,026 (0.065)	-0,006	-0,055 (0.069)	-0,012	0,237* (0.071)	0,053*	-0,104 (0.069)	-0,023
Karlovarský	-0,116 (0.091)	-0,018	-0,267 (0.096)	-0,040	0,160 (0.100)	0,024	-0,282 (0.097)	-0,043
Ústecký	-0,187* (0.061)	-0,046*	-0,203* (0.064)	-0,050*	0,209* (0.067)	0,051*	-0,163 (0.065)	-0,040
Liberecký	0,017 (0.078)	0,003	-0,159 (0.083)	-0,028	0,132 (0.086)	0,024	-0,270* (0.084)	-0,048*
Královehradecký	0,024 (0.069)	0,005	-0,141 (0.073)	-0,029	0,169 (0.076)	0,035	-0,151 (0.074)	-0,031
Pardubický	0,010 (0.066)	0,002	-0,010 (0.070)	-0,002	0,092 (0.072)	0,020	-0,349** (0.071)	-0,076**
Vysočina	-0,054 (0.073)	-0,011	-0,103 (0.078)	-0,020	0,264* (0.080)	0,052*	-0,261* (0.078)	-0,051*
Jihomoravský	0,060 (0.050)	0,019	-0,028 (0.053)	-0,009	0,120 (0.055)	0,037	-0,130 (0.054)	-0,041
Olomoucký	-0,113 (0.064)	-0,026	-0,103 (0.068)	-0,023	0,126 (0.070)	0,029	-0,318** (0.069)	-0,072**
Zlínský	-0,009 (0.060)	-0,002	-0,024 (0.064)	-0,006	0,293** (0.066)	0,073**	-0,207* (0.064)	-0,051*
Moravskoslezský	-0,043 (0.052)	-0,013	-0,021 (0.055)	-0,006	0,202** (0.057)	0,061**	-0,273** (0.056)	-0,082**
Size	0,206** (0.010)	0,311**	0,073** (0.010)	0,110**	0,105** (0.011)	0,159**	0,087** (0.010)	0,132**
Ownership (foreign)	-0,013 (0.032)	-0,006	-0,032 (0.034)	-0,014	-0,015 (0.035)	-0,007	0,130** (0.034)	0,059**
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.215		0.114		0.055		0.098	

Note: Number of observations 4 771; ** significant at 0.01 level, * significant at 0.05 level

Contrary to our assumption, the ownership variable, i.e. whether the firm is domestic or under foreign control, does not seem to play important role either, with the exception of the non-technological innovation mode. Hence we might assume that companies under foreign control located in the Czech Republic focus particularly on non-technological innovations. This is in line with Dicken (2007) who argues that TNCs often locate their core R&D activities in large establishments in their home country close to corporate headquarter taking advantage of economies of scale. On the other hand, by far the most common form of overseas R&D activities is the so called "support laboratory" responsible primarily for adapting parent company technology to the local market (Dicken, 2007, p. 144, see also Annique Un, Cuervo-Cazurra 2008, Sachwald 2008) and, according to Dicken (2007) only a few global corporations operate internationally independent laboratories.

Concluding remarks and policy implications

This paper has empirically analysed how firms organize their innovative activities using broad firm-level survey datasets of manufacturing and service sectors from the Czech Republic. Using hierarchical factor analysis, we found four distinct modes of the innovation process.

Before summarizing the results and its implications, let us mention some limitations of this study. First, it is considered as a starting point for further analysis and research in the sphere of regional innovation systems, their emergence, dynamic and delineation. Thus, it brings particularly insights into where the research might go rather than clear-cut conclusions. Second, the analysis does not attempt to measure the long-term trends and changes of different innovation strategies (as well as regional innovation systems) and so it is not possible to determine whether the current results are more or less sustainable over time or whether they will change significantly. This is one of the directions which the author would like to follow.

The four innovations modes identified are to a great extent similar to previous studies focused on more developed countries, with only small differences related to the last innovation mode labelled "non-technological". This innovation mode seems to group less innovative companies and companies from symbolic and creative industries groups with focus on non-technological innovations as the factor does not load on any of the innovating activities. There have been also identified slight differences in some of the innovation modes ingredients which similarly point out to some specifics of Czech companies innovating activities. However, the innovation modes detected, which seem to be generally in line with previous studies, show only the presence of the associated innovation modes in the Czech innovation systems, not their significance or more detailed information. This should be subject to further analysis to be able to better explain and describe the position of the Czech Republic, particularly when data for longer period is available. In this follow-up analysis we should supplement the quantitative analysis with case studies as the innovation surveys are to a large extent dependent on subjective information and answers. The detailed case studies should help to reveal whether a different perception does not lead to similar results yet with dissimilar interpretations and meanings.

In the second part of our analysis, we focused on the role of regional level examining whether we might observe emergence of specific regional innovation systems (associated with administrative regions) in the Czech Republic. The analysis has shown that regions matter to a certain degree yet in case of most of the regions the differences in innovation modes are not statistically significant. This might be attributed to the fact that the administrative regions were established first in 2001 and only recently gained a more significant political and economic power. On the other hand, the results are quite contradictory to existing regional disparities in economic level, growth, employment characteristics and also R&D inputs and outputs. Hence, the analysis shows that taking administrative borders as borders of the regional innovation systems might not always be accurate, particularly in case of a small country such as the Czech Republic. Though from a different perspective, Varro (2008) also argues that the emergence of regions as key economic and political players is far from assured and regions in EU on the whole remain rather weakly institutionalized. Existing (administrative) regions as strong, specific regional innovation systems thus remain rather a presumptions than empirically validated reality.

The analysis as rather illustrative does not provide any conclusive results and its objective is mainly to highlight and delineate the research questions that should be addressed in more in-depth future empirical research. It leads us to a conclusion that we should aim at delineating "natural" innovation systems through a bottom up analysis. The focus on more qualitative and descriptive studies in the past was justified by lack of data available for the regional level. Currently, more detailed data even at lower geographical level is becoming available, and so this empirical, bottom-up approach seems to be promising. On the other hand, it is necessary to stress that our analysis has focused on the differences in organization of innovation process but not on the differences in innovation inputs. The available data are also missing important

characteristic of the innovation systems which gives them actually the systemic character, and that is a better description of linkages and interactions. Therefore, in further analysis aimed at the delineation of the RIS one might need to use broader database and a complementary qualitative analysis to analyse the nature of interactions.

The analysis brings also questioning of the current trends in innovations policies dominated by strong process of regionalization. The policy-makers have taken for granted the theoretical presumptions about the association of regional innovation systems with existing administrative regions and stressed need to transfer the competencies for its support to regional level. Yet, this paper empirically questions these taken-for-granted notions and leads us to think more carefully about the organization of innovation process. To summarize, what in our opinion is the main implication of this paper is that it points in the direction of new research questions. At the same time, we should ask this question at the very beginning of the definition of the innovation system concepts. The question is what the boundaries of (regional) innovation systems are.

Acknowledgment

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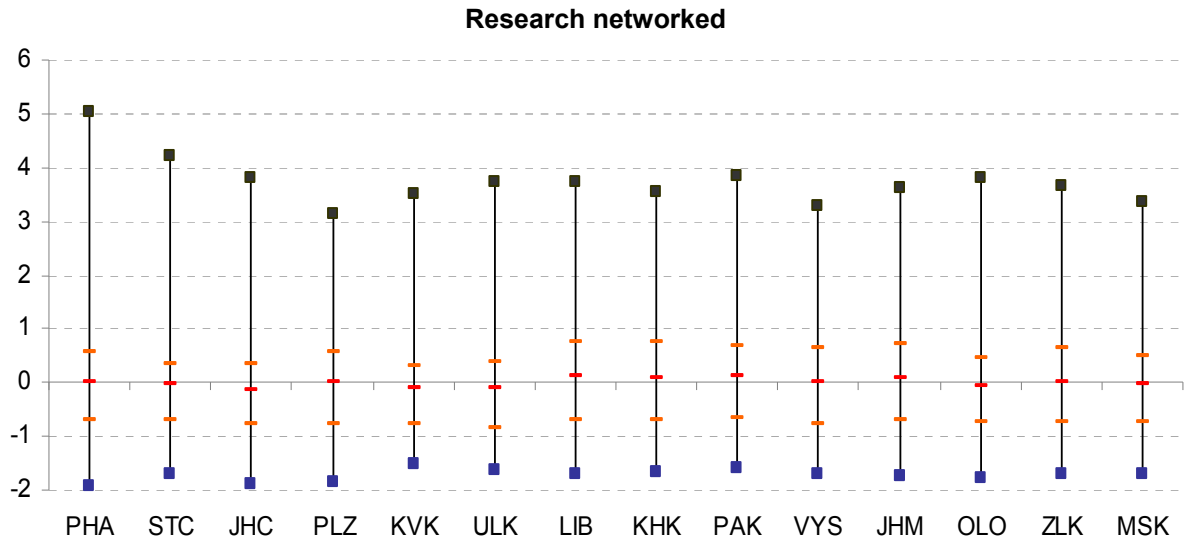
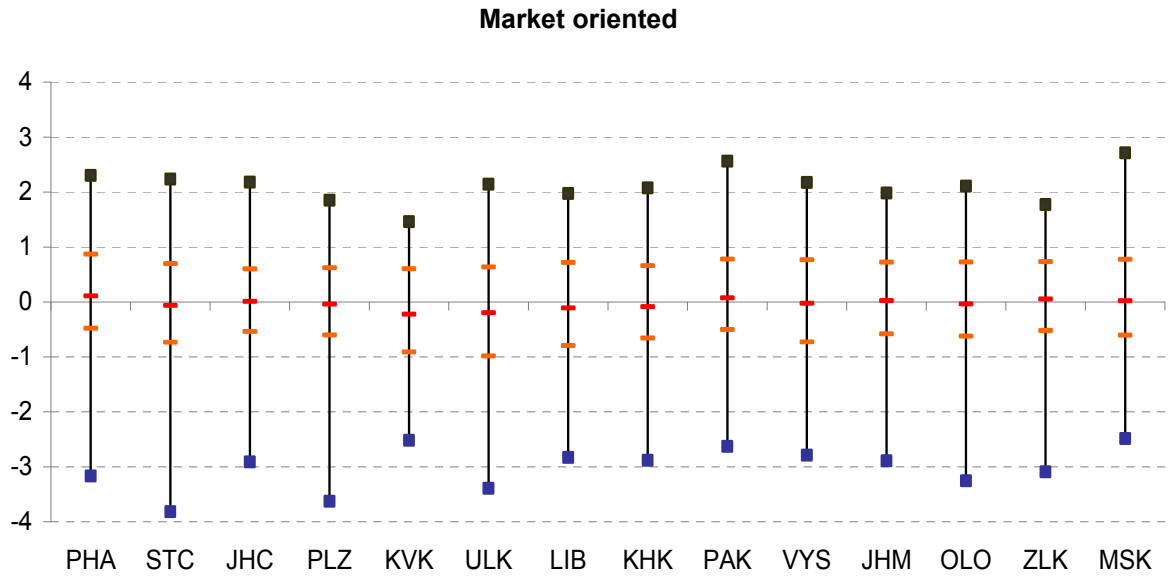
Appendix A: First-step factor analysis variables

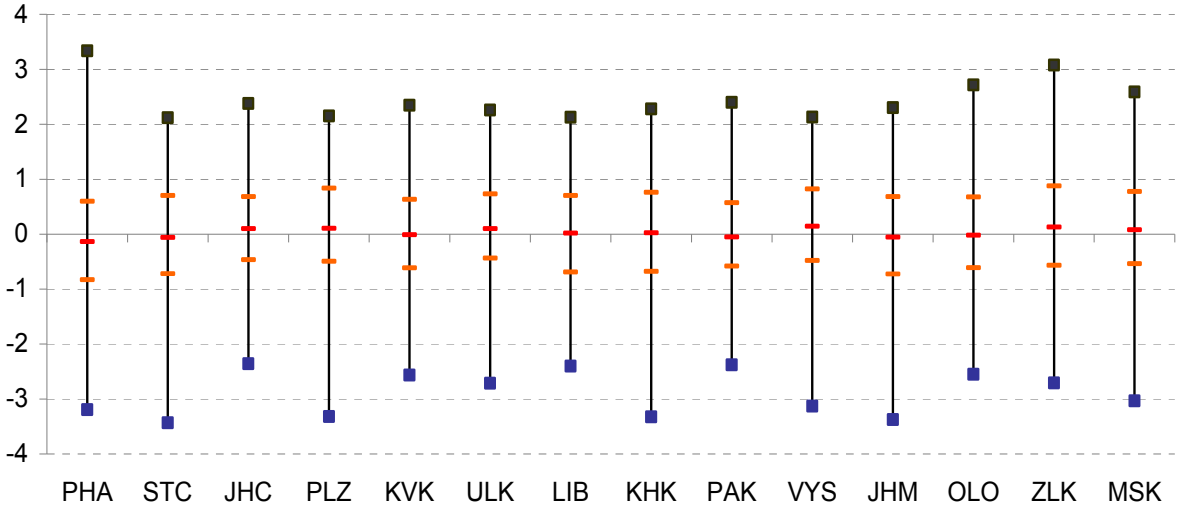
Set of questions	Variable	Answer
Engagement in innovation activities	In-house R&D	yes/no
	External R&D	
	Acquisition of machinery, equipment and software purchased to implement innovations	
	Acquisition of other external knowledge (licence, know-how)	
	Internal or external training aimed at implementation of innovation	
	Market introduction of new products and services	
	Other activities (technical preparation aimed at implementation of innovations)	
Information sources	Within the enterprise	Likert scale 0 not relevant -3 highly important
	Suppliers of equipment, materials, components or software	
	Clients or customers	
	Competitors or firms from the same industry	
	Consultants, commercial laboratories or private R&D institutes	
	Universities or other higher education institutes	
	Government or public R&D institutes	
	Conferences, trade fairs, exhibitions	
	Journals and technical publications	
	Professional and industry associations	
Innovation co-operation - geographical dimension	Czech Republic	yes/no
	Other Europe	
	USA	
	Other world	
Effects of innovations	Increased range of products	Likert scale 0 not relevant -3 highly important
	Increased markets or market share	
	Improved quality in products	
	Increased production flexibility	
	Increased production capacity	
	Reduced labour cost per unit	
	Reduced material and energy consumption per unit	
	Reduced negative environmental impact and improved safety and health aspects	
	Meeting regulations	
Intellectual property protection	Patent application	yes/no
	Industrial design registration	
	Trademark	
	Copyright	
Organizational and marketing innovations	Implementation of new or significantly changed management system	yes/no
	Implementation of significantly changed work organization within the enterprise	
	Implementation of significant changes in relations to other enterprises or public institutions (e.g. alliances, outsourcing, partnership)	
	Significant changes in design or packaging of the product	
	Changing significantly the firm's sales and distribution methods	

Appendix B: Regional distribution of the factor scores according to the four identified innovation modes (minimum, maximum, mean, quartiles)

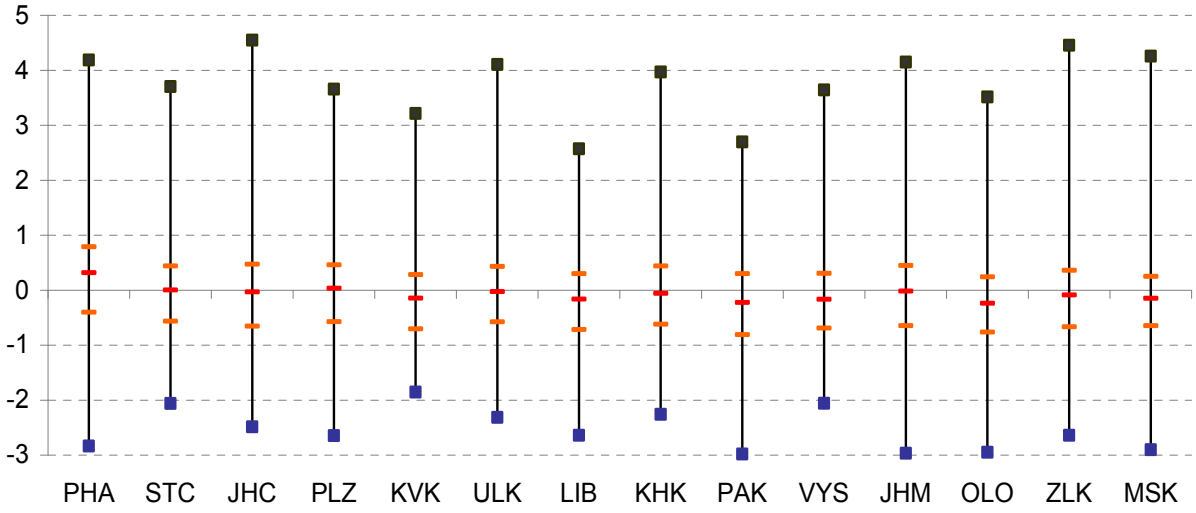




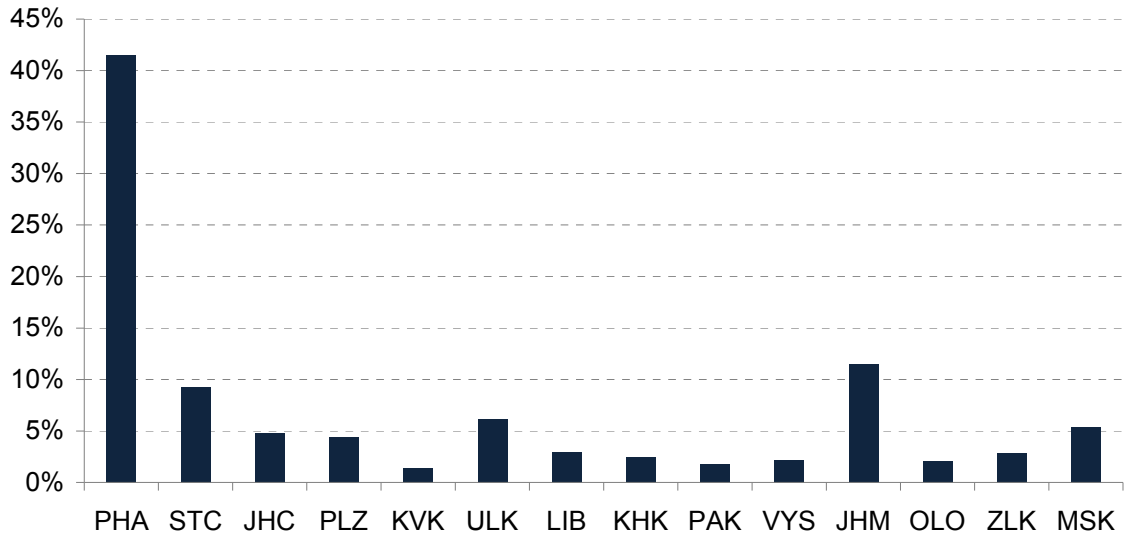
External



Non-technological

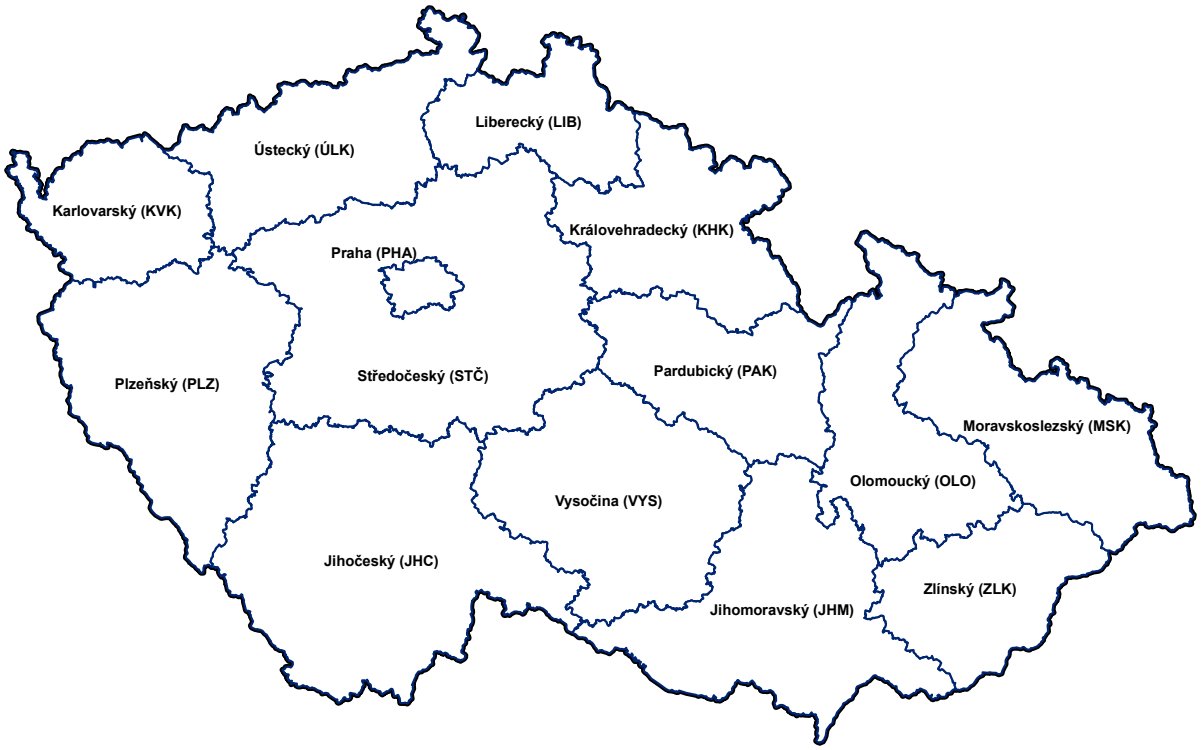


Appendix C: Share of regional employment on creative/symbolic industries on the total employment in the Czech Republic, 2006



Source: CZSO – Labour Force Survey 2006

Appendix D: Czech administrative self-governing regions



References

Annique Un, C., Cuervo-Cazurra, A. 2008. Do subsidiaries of foreign MNEs invest more in R&D than domestic firms? Research Policy, 37 (10), 1812-1828.

Asheim, B. 2000. Industrial Districts: The Contribution of Marshall and Beyond. In: Gordon, L. C., Feldman, M. P., Gertler, M. S. eds.: The Oxford Handbook of Economic Geography, Oxford University Press, Oxford, 413-431.

Asheim, B. 1999. Interactive Learning and Localised Knowledge in Globalising Learning Economies. GeoJurnal, 49, 345-352.

Asheim, B., Isaksen, A. 2002. Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge. Journal of Technology Transfer, 27 (1), 77-86.

Asheim, B., Coenen, L., Vang, J. 2007. Face-to-face, buzz, and knowledge bases: socio-spatial implications for learning, innovation, and innovation policy. Environment and Planning C: Government and Policy, 25 (5), 655 – 670.

Bathelt, H., Malmberg, A., Maskell, P. 2004. Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation, Progress in Human Geography, 28 (1), 31-56.

Blažek, J. 2005. Trends to regional disparities in the Czech Republic in pre-accession period in the European context, Geographia Polonica, 78 (2), 91-106.

Blažek, J., Csank, P. 2007. Nová fáze regionálního rozvoje v ČR? Sociologický časopis, 43 (5), 945-965.

Blažek, J., Uhlíř, D. 2007. Regional Innovation Policies in the Czech Republic and the Case of Prague: An Emerging Role of a Regional Level? European Planning Studies, 15 (7), 871-888.

Braczyk, H. J., Cooke, P., Heidenreich, M. 2004. Regional Innovation Systems. The Role of Governance in a Globalized World. Routledge, London, second edition, 438 p.

Breschi, S, Malerba, F. 1997. Sectoral Innovation Systems: Technological Regimes, Schumpeterian Dynamics, and Spatial Boundaries. In Edquist, C. (ed.) Systems of Innovation: Technologies, Institutions and Organization. Pinter, London, 130-156.

Buesa, M., Heijs, J., Martinez Pellitero, M., Baumert, T. 2006. Regional systems of innovation and the knowledge production function: the Spanish case. Technovation, 26, 463-472.

Cooke, P. 2005. Regionally asymmetric knowledge capabilities and open innovation: Exploring 'Globalisation 2' – A new model of industry organization. Research Policy, 34 (8), 1128-1149.

Cooke, P. 2003. Strategies for Regional Innovation Systems: Learning Transfer and Applications. United Nations Industrial Development Organization, Vienna, 38 p.

David, P. A. 2005. Path dependence in economic processes: implications for policy analysis in dynamical systems contexts. In Dopfer, K. (ed.) The Evolutionary Foundations of Economics. Cambridge University Press, Cambridge, 151-194.

De Jong, J. P. J., Marsili, O. 2006. The fruit flies of innovations: A taxonomy of innovative small firms. Research Policy, 35 (2), 213-229.

Dicken P. 2007. Global Shift, Fifth Edition: Mapping the Changing Contours of the World Economy. The Guilford Press, New York.

Doloreux, D. 2002. What we should know about regional systems of innovation, Technology Society 24, 243–263.

Doloreux, D., Parto, S. (2004): Regional Innovation Systems: A Critical Synthesis. UNI-INTECH Discussion Paper, The United Nations University, Institute for New Technologies, UNU-INTECH, 38 s.

Dosi, G. 1988. Sources, procedures and microeconomic effects of innovation. Journal of Economic Literature 26, 1120-1171.

Edquist, C. 2005. Systems of Innovation: Perspectives and Challenges. In: Fagerberg, J., Mowery, D. C., Nelson, R.: The Oxford Handbook of Innovation, Oxford University Press, Oxford, 181-208.

Edquist, C. 1997. Systems of Innovation Approaches—Their Emergence and Characteristics. In Growth, Competitiveness Employment. Edward Elgar, Chetenhalm.

Fagerberg, J., Mowery, D., Verspagen, B. 2008. Innovation-systems, path-dependency and policy: The co-evolution of science, technology and innovation policy and industrial structure in a small, resource-based economy. Working Papers on Innovation Studies, Centre for Technology, Innovation and Culture, University of Oslo.

Fritsch, M., Stephan, A. 2005. Regionalization of innovation policy - Introduction to the special issue. Research Policy, 34 (8), 1123-1127.

Havas, A. 2006. Knowledge intensive Activities versus High-tech Sectors: Learning Options and Traps for Central European Policy-makers. In: Piech, K., Radosevic, S. (eds.): The Knowledge-based Economy in Central and Eastern Europe. Countries and Industries in a Process of Change, Palgrave, New York, 259-279.

Heidenreich, M., Krauss, G. 2004. The Baden-Wűrttemberg production and innovation regime: Past successes and new challenges. In Braczyk, H. J., Cooke, P., Heidenreich, M. (eds) Regional Innovation Systems. The Role of Governance in a Globalized World. Routledge, London, second edition, 186-213.

Hollenstein, H., 2003. Innovation modes in the Swiss service sector: a cluster analysis based on firm-level data. Research Policy 32 (5), 715–885.

Iammarino, S. 2005. An Evolutionary Integrated View of Regional Systems of Innovation: Concepts, Measures and Historical Perspectives. European Planning Studies, 13 (4), 497-519.

Koschatzky, K. 2004. The role of R&D services in managing regional knowledge generation – a regional differentiation. In: Karlsson, C. Flensburg, P., Hörte, S-Å. (Eds.): Knowledge Spillovers and Knowledge Management. Edward Elgar, Cheltenham, 237-267.

Kristensen, F. S. 1999. Towards a Taxonomy and Theory of the Interdependence between Learning Regimes and Sectorial Patterns of Innovation and Competition: an Empirical Analysis of an Elaborated Pavitt Taxonomy applying Danish Data. Paper to be presented at the DRUID Winter conference, Seeland, Denmark, January 1999.

Leiponen, A., Drejer, I. 2007. What exactly are technological regimes? Intra-industry heterogeneity in the organization of innovation activities. Research Policy, 36 (8), 1221-1238.

Lewis-Beck, M. S. 1994. Factor Analysis and Related Techniques. SAGE Publication, London, UK.

Lundvall, B. Å. 1992. National Systems of Innovation. Pinter, London.

Malerba, F., Orsenigo, L. 1996. Schumpeterian patterns of innovation are technology-specific. Research Policy 25 (3), 451-478.

Marinova, D., Philimore, J. 2003. Models of Innovation. In Shavinina, L., V. (ed.) The International Handbook on Innovation, Pergamon, Elsevier Science Ltd., Oxford, 44-53.

Martin, R., Sunley, P. 2006. Path dependence and regional economic evolution. Journal of Economic Geography, 6 (4), 395-437.

Maskell, P., Malmberg, A. 2007. Myopia, knowledge development and cluster evolution. Joural of Economic Geography, 7 (5), 603-618.

Maskell, P., Malmberg, A. 1999. Localised learning and industrial competitiveness. Cambridge Journal of Economics, 23, 167–185.

Morgan, K. 1997. The Learning Region: Institutions, Innovation and Regional Renewal. Regional Studies, 31, 5, p. 491-503.

Moulaert, F., Sekia, F. 2003. Territorial Innovation Models: A Critical Survey. Regional Studies 37 (3), 289 – 302.

Nelson, R. (Ed.) 1993. National Innovation Systems: A Comparative Analysis. Oxford University Press, Oxford.

Nelson, R., Winter, S. 1982. An evolutionary theory of economic change. Bellknap, Cambridge, Massachusetts.

North, D. C. 1990. Institutions, Institutional Change and Economic Performance, Cambridge University Press, Cambridge.

OECD 1997. Proposed guidelines for collecting and interpreting technological innovation data: the 'Oslo Manual'. Organisation for Economic Development and Co-operation, Paris.

OECD 1996. The Knowledge-based Economy. OECD, Paris.

Pavitt, K. 1984. Sectoral patterns of technical change: towards a taxonomy and a theory. Research Policy, 13 (6), 343–373.

Raymond, W., Mohnen, P., Palm, F., Schim van der Loeff, S. 2004. An Empirically-Based Taxonomy of Dutch Manufacturing: Innovation Policy Implications. CESifo Working Paper Series No. 1230.

Sachwald, F. 2008. Location choices within global innovation networks: the case of Europe. Journal of Technology Transfer, 33 (4), 364-378.

Schumpeter, J. A. 1934. The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. Harvard University Press, Cambridge, Massachusetts.

Schumpeter, J. A. 1942. Capitalism, socialism, and democracy. Harper, New York, 381 p.

Simmie, J. 2002. Trading Places: Competitive Cities in the Global Economy. European Planning Studies, 10 (2), 201-214.

Srholec, M., Verspagen, B. 2008. The Voyage of the Beagle in Innovation Systems Land. Explorations on Sectors, Innovation, Heterogeneity and Selection. TIK Working Paper on Innovation Studies, Centre for Technology, Innovation and Culture, University of Oslo, Norway.

Storper, M. 1997. The regional world : territorial development in a global economy. Guilford Press, New York.

Tödling, F., Trippl, M. 2005. One size fits all? Towards a differentiated regional innovation policy approach. Research Policy, 34 (8), 1203-1219.

Varro, K. 2008. Changing Narratives on EU Multi-level Space in a Globalizing Era: How Hungary as a National Space Became Part of the Story. European Planning Studies, 16 (7), 955-969.

Veugelers, R., Cassiman, B. 1999. Make and buy in innovation strategies: evidence from Belgian manufacturing firms. Research Policy, 28 (1), 63-80.

Žížalová, P. 2008. Knowledge and innovation collaboration patterns: some insights from a post-communist country. DIME International Workshop "Reconsidering the Regional Knowledge Economy: Theoretical, Empirical and Policy Insights from Diverse Research Approaches", Newcastle, UK, September 2008.

Žížalová, P., Csank, P. 2009 forthcoming. Key regional development processes – research, development and innovation? Geografie – Sborník České geografické společnosti.